

PATENT COOPERATION TREATY

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INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference TS 6454 PCT	FOR FURTHER ACTION <div style="text-align: right;">See Form PCT/PEA/416</div>	
International application No. PCT/EP2004/053182	International filing date (day/month/year) 30.11.2004	Priority date (day/month/year) 29.12.2003
International Patent Classification (IPC) or national classification and IPC H01M10/40, H01M10/39, H01M10/36, H01M6/14, H01M6/16, H01G9/02		
Applicant SHELL INTERNATIONALE RESEARCH MAATSCHAPPIJ B.V.		
<p>1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 6 sheets, including this cover sheet.</p> <p>3. This report is also accompanied by ANNEXES, comprising:</p> <p>a. <input type="checkbox"/> sent to the applicant and to the International Bureau a total of sheets, as follows:</p> <p style="margin-left: 40px;"><input type="checkbox"/> sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).</p> <p style="margin-left: 40px;"><input type="checkbox"/> sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.</p> <p>b. <input type="checkbox"/> (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).</p>		
<p>4. This report contains indications relating to the following items:</p> <p><input checked="" type="checkbox"/> Box No. I Basis of the opinion</p> <p><input type="checkbox"/> Box No. II Priority</p> <p><input type="checkbox"/> Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</p> <p><input type="checkbox"/> Box No. IV Lack of unity of invention</p> <p><input checked="" type="checkbox"/> Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</p> <p><input type="checkbox"/> Box No. VI Certain documents cited</p> <p><input type="checkbox"/> Box No. VII Certain defects in the international application</p> <p><input type="checkbox"/> Box No. VIII Certain observations on the international application</p>		
Date of submission of the demand 21.10.2005	Date of completion of this report 21.12.2005	
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized Officer Götz, H Telephone No. +49 89 2399- <div style="text-align: right;">  </div>	

**INTERNATIONAL PRELIMINARY REPORT
ON PATENTABILITY**

International application No.
PCT/EP2004/053182

Box No. I Basis of the report

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.
- ☐ This report is based on translations from the original language into the following language , which is the language of a translation furnished for the purposes of:
- ☐ international search (under Rules 12.3 and 23.1(b))
 - ☐ publication of the international application (under Rule 12.4)
 - ☐ international preliminary examination (under Rules 55.2 and/or 55.3)
2. With regard to the **elements*** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:

Description, Pages

1-24 as originally filed

Claims, Numbers

1-26 as originally filed

Drawings, Sheets

1-9 as originally filed

- ☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing
3. ☐ The amendments have resulted in the cancellation of:
- ☐ the description, pages
 - ☐ the claims, Nos.
 - ☐ the drawings, sheets/figs
 - ☐ the sequence listing (*specify*):
 - ☐ any table(s) related to sequence listing (*specify*):
4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).
- ☐ the description, pages
 - ☐ the claims, Nos.
 - ☐ the drawings, sheets/figs
 - ☐ the sequence listing (*specify*):
 - ☐ any table(s) related to sequence listing (*specify*):

* If item 4 applies, some or all of these sheets may be marked "superseded."

**INTERNATIONAL PRELIMINARY REPORT
ON PATENTABILITY**

International application No.
PCT/EP2004/053182

Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes: Claims	1-26
	No: Claims	
Inventive step (IS)	Yes: Claims	1-26
	No: Claims	
Industrial applicability (IA)	Yes: Claims	1-26
	No: Claims	

2. Citations and explanations (Rule 70.7):

see separate sheet

Re Item V

**Reasoned statement with regard to novelty, inventive step or industrial applicability;
citations and explanations supporting such statement**

1. Cited documents

- D1: WO 01/15258 A (MONASH UNIVERSITY; MACFARLANE, DOUGLAS, ROBERT; FORSYTH, MARIA; HUANG,) 1 March 2001 (2001-03-01)
- D2: MACFARLANE D R ET AL: "Pyrrolidinium imides: a new family of molten salts and conductive plastic crystal phases" 20 May 1999 (1999-05-20), JOURNAL OF PHYSICAL CHEMISTRY. B, MATERIALS, SURFACES, INTERFACES AND BIOPHYSICAL, WASHINGTON, DC, US, PAGE(S) 4164-4170 , XP002211103
ISSN: 1089-5647
- D3: US 2002/055045 A1 (MICHOT CHRISTOPHE ET AL) 9 May 2002 (2002-05-09)

2. Summary

The application discloses an electrochemical element with an electrolyte comprising an ionic liquid comprising a cation having a pyrrolidinium ring structure and an anion. The active cathode material contains an intercalation material having an upper reversible-potential-limit of at most 4 V versus Li/Li⁺.

Moreover, the application discloses a method of providing energy in an underground wellbore with the electrochemical element described above.

The application solves the problem of providing suitable combinations of a pyrrolidinium based ionic liquid and active cathode materials for rechargeable batteries at temperatures between 60 and 150 °C (application: page 12, line 14 - 32).

3. Novelty, Article 33(1) PCT

3.1 D1 and D2 disclose ionic liquids for lithium batteries comprising a cation with a N-alkyl-N-alkyl-pyrrolidinium ring structure (D1: page 5 (ii); examples 1-4 and D2: pages 4165-

4166) and an anion. However, an active cathode material suitable for use with these ionic liquids is not further specified.

D1 solves the problem of providing an electrolyte for lithium batteries with a high ion conductivity and at the same time non-volatility and non-flammability (page 1, line 13-30).

3.2 D3 relates to ionic liquids for lithium batteries however a cation with a N-alkyl-N-alkyl-pyrrolidinium ring structure is not disclosed.

3.3 Independent product claim 1 and independent method claim 24 are consequently novel with respect to D1-D3.

4. Inventive step, Article 33(2) PCT

4.1 D1 is considered as closest prior art for independent claim 1. Claim 1 differs from D1 in that the active cathode material comprises an intercalation material having an upper reversible-potential-limit of at most 4 V versus Li/Li⁺. The resulting effect is an improved cycling behaviour (see experiments I-VI). The problem to be solved is the provision of suitable combinations of a pyrrolidinium based ionic liquid and active cathode materials for rechargeable batteries at temperatures between 60 and 150 °C (application: page 12, line 14 - 32; page 23, line 23 - 29). D2 is silent with respect to the nature of the active cathode material and D3 refers to different ionic liquids. The active cathode materials disclosed in the invention are known (see application pages 4-6), however their combination with a pyrrolidinium based ionic liquid is neither disclosed nor hinted at by the cited prior art.

4.2 A similar reasoning applies to independent method claim 24 and all claims dependent on claims 1 and 24, which therefore meet the requirements of Article 33(2) PCT.

5. Industrial applicability, Article 33(4) PCT

5.1 The invention finds industrial use in the field of batteries and therefore complies with the requirements of Article 33(4) PCT.

**INTERNATIONAL PRELIMINARY
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(SEPARATE SHEET)**

International application No.

PCT/EP2004/053182